B.E. CONSTRUCTION ENGINEERING THIRD YEAR SECOND SEMESTER EXAM- 2023

Time : Three hours

Subject: **HIGHWAY ENGINEERING**

(50 Marks for each Part)

Use separate answer script for each Part

Full Marks : 100

PART I (50 Marks)

Answer any two questions .

Assume relevant data wherever required

CO1 Q-1. (a) Draw cross sectional diagrams with constituent materials for conventional bituminous and concrete road pavement. [6]

CO2 (b) Discuss relative advantage and disadvantage of using CTB and CTSB in bituminous road pavement. [6]

CO2 © Explain the significance of using RAP in pavement construction. [5]

CO3 (d) Briefly discuss the standard wheel load of single axle , tandem axle and tridem axle load as per IRC specifications. [3]

CO3 (e) write notes on lane distribution factor. [5]

CO4 Q-2. (a) An existing two lane undivided national highway near Digha has to be widened to four lane divided carriage way with present traffic of 1A38 cvpd . Estimate the design load for the road. [5]

CO4 (b) A village road near Siliguri carries present traffic of 16A cvpd with a subgrade CBR of 6% . Design the thickness of a concrete pavement for the proposed road section.

Given - *Effective k value over Granular and Cementitious Sub-bases*

Soaked Sub-grade CBR (%)	**2**	**3**	**4**	**5**	**7**	**10**	**15**	**20**	**50**
K value over GSB (150 to 250 mm), MPa/m	25	34	42	50	58	60	74	83	170
K value over Cementitious sub-base (150 to 200 mm), MPa/m	42	56	70	84	96	100	124	138	280

Use Cementitious sub base in design . [20]

CO3 Q-3 (a) Write notes on temperature correction and moisture correction in relation to rebound deflection measurement. [8]

CO4 (b) Explain rutting and fatigue in pavement . What are the causes of rutting and fatigue ? how rutting can be controlled in flexible road pavement .

[3 + 3 + 3]

CO4 © Explain the reasons of top down and bottom up cracks in concrete pavement. [8]

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Time: Three hours **PART-II** Full Marks: 50

Different parts of the same question should be answered together.

CO2 [25]	Answer all questions in this block 1. (a) Mention three grade of bitumen, in general use on road work and say where and why each grade is suitable? (b) Describe Plate Load Test with neat sketches. What is the significance of Plate load test? Briefly narrate significance of GI test of soil from the view point of highway material? **OR** CBR test results as on a road sub grade are shown in the Table 1 below. What is the design CBR value of the subgrade? Proving Capacity (LOAD) = **1000kg**, Proving Ring Maximum division = **9XX** **XX = Last two digit of your EXAM Roll No. (e.g. if EXAM Roll no is CON…10<u>41</u>, so XX= 41, proving ring maximum division = 941)** [8+17]
CO3 [25]	Answer all questions in this block (a) Describe the essential features of cold mix technology **OR** Compare between HOT MIX and COLD MIX (b) The results of a Marshall test is listed below in Table 2.0. (i) Find V_v, V_b VMA and VFB (ii) what will be the optimum bitumen content? (Assume relevant data if required) (c) The aggregates in a bituminous mix are with 10% asphalt by weight of mixture. The specific gravity of asphalt is 1. Compacted specific gravity of void less specimen of this mixture is 2.3. Determine the effective specific gravity of the aggregate. **OR** Write short note on different type of Bituminous mix. [3+18+4]

The students of the course should be able to

CO1:	Illustrate the factors affecting geometric design of roads and airports. (K2)
CO2:	Describe different Road Construction Materials and their applications in construction of flexible pavements (K2, A1)
CO3:	Illustrate design of bituminous mix for use in flexible pavement. (K3)
CO4:	Use Indian Standard Guidelines for obtaining thickness of overlay. (K3)
CO5:	Use Indian Standard Guidelines for solving problems on Flexible and Rigid Pavements design (K3)

Table 1 Laboratory test data of CBR test

Penetration		PRIVING RING		
STRAIN DIAL	mm	Dial Gauge Reading		
50.0	0.5	21	8	12
100.0	1.0	39	19	18
150.0	1.5	58	29	21
200.0	2.0	73	39	29
250.0	2.5	86	49	36
300.0	3.0	99	58	41
350.0	3.5	110	67	47
400.0	4.0	119	75	52
450.0	4.5	127	82	56
500.0	5.0	135	88	59
600.0	6.0	148	97	166
700.0	7.0	160	105	171
800	8.0	170	111	176.5
900	9.0	179	118.5	181.5
1000	10.0	188	123	186
1250	12.5	207	135	296

Table 2.0 Laboratory test data of Marshall Test

Binder content	Thickness of specimen (mm)			Weight in Air (gm)			Weight in Water (gm)		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
4.00%	63.26	62.48	61.61	1228	1219.5	1205.5	716.5	712.2	705.3
4.50%	64.98	63.96	63.28	1277	1252.6	1243.5	747.3	733.3	730.7
5.00%	63.58	63	63.44	1254	1238.3	1239	738.2	726.8	724.9
5.50%	62.93	65.93	64.87	1238	1300	1273.6	727	763.6	746.9
6.00%	63.21	64.46	65.77	1237	1264	1286.4	724.1	740.6	752.4

Binder content	Thickness of specimen (mm)			Weight in Air (gm)		
	S1	S2	S3	S1	S2	S3
4.00%	1049.4	991.2	1012.4	2.2	2.07	2.15
4.50%	1148.5	1085.9.	1102.2	2.57	2.35	2.31
5.00%	1114.7	1147.4	1142.5	3.18	3.24	3.12
5.50%	1020.6	1031.5	1039.7	3.64	3.54	3.66
6.00%	788.2	879.1	833.3	3.86	3.78	3.75

Component	Specific Gravity	Weight (g)
Coarse Aggregate	2.76	8000
Fine Aggregate	2.66	4000
Filler	2.77	414
Bitumen	1.05	Depends on %